Grantee: UAF – Institute of the Northern Engineering
Project Name: Enhanced Condensation for Organic Rankine Cycle
Grant and Project# 7310028

Grant Completion Report

Background:

Condensation is one of the most important heat transfer processes. A greater rate of heat transfer would be a substantial benefit to Organic Rankine Cycle (ORC) systems. The majority of the total cost for operation and maintenance of an ORC system stems from its condenser. This project used heterogeneous condensing surfaces to increase heat transfer.

Activities:

Institute of the Northern Engineering developed a mathematical model to describe the condensation process of organic fluids and to predict the heat transfer rates both on the conventional homogenous and proposed heterogeneous surfaces. Samples were studied for different operation conditions and orientations for the striped heterogeneous samples. Data was analyzed to calculate the condensation heat transfer coefficients. A longevity test was performed to identify any degradation due to continuous operation.

Project Costs:

	Budget	Expenditures
Grant	$166,044	$166,044
Match	$ 30,168	$ 30,168
Total	$196,212	$196,212

Project Outcomes:

Data found that the proposed heterogeneous surface samples provide enhanced heat transfer rates compared to the conventional homogeneous surfaces. The enhancement was maximum at approximately 170% when the stripes of heterogeneous surface orient horizontally. The longevity test showed that this performance continued after 500 operation hours.

Problems Encountered:

The project evaporation chamber exploded during testing because of the compatibility between plastic materials and organic fluids. A compatible replacement was installed to complete testing.

Conclusions and Recommendations:

Initial tests produced two findings: 1) proposed condensing surface outperformed a non-treated condensing surface, 2) the angle of the stripes that formed by the design of the heterogeneous condensing surface is a key factor. The proposed condensing surface exceeded the set goal but in a limited subcooling range. It is recommended that the proposed condensing surfaces are used for ORC systems under the operation conditions of 2 ~ 4 K of subcooling to maximize the enhancement.